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How does drained peatland respond to wildfire?

Wildfires could release up to nine times more stored carbon from drained peatland at high latitudes than from untouched peatland in the same region, according to a recent study. As climate change is expected to both dry out peatland and increase the frequency of wildfires, the results have serious implications for the role of northern peatlands as carbon sinks or sources.

Peat soils, which are formed gradually from plant matter that partly decomposes in acidic, oxygen-poor conditions, sequester a large amount of carbon from the atmosphere. As a result, climate models predict that peatland could help delay the most damaging effects of anthropogenic climate change.

However, changes, such as increased agriculture, development or rising temperatures caused by climate change, could cause peatlands to dry out. Climate change is also predicted to increase the number of wildfires. Researchers and policymakers are concerned that anything which changes conditions within the peat could result in the release of thousands of years of stored carbon, greatly accelerating climate change.

A long-term experiment in peat drainage, first set up in Alberta, Canada, in 1983, provided researchers with an opportunity to investigate the impacts of such changes. Here, an area of high latitude fen with tree cover was drained via a series of drainage ditches. This lowered the water table by around 10cm. A 105,000ha wildfire in 2001 subsequently burned part of the experimental area, affecting both drained and un-drained, or pristine, plots. In 2003, the researchers examined the effect of wildfire on drained and pristine peat. They also studied the impact of draining on carbon sequestration in peat.

The study revealed that, during the 2001 wildfire, the top seven centimetres of the pristine peat burned, resulting in the release of around two kilograms of carbon per square metre. In contrast, the top 19 centimetres of the drained peat burned. As peat becomes denser at greater depths, this released almost 17kg of carbon per square metre; almost nine times as much, accounting for 450 years of carbon storage. The higher water table of the pristine peat meant that only 58 years of stored carbon was lost.

To understand the long-term effects of peat drainage on carbon emissions from peatland regularly affected by wildfires, the researchers also looked at the rate of organic matter accumulation in the peat. They found that, contrary to expectations, the drained peat plots gained twice as much stored carbon as the as the pristine peatland (68.7g per m^2 per year compared to 33.9g per m^2 per year). Usually, increased microbial activity in drained peat results in a loss of soil carbon. Although the study didn't quantify carbon fluxes in the soil, the researchers believe that increased tree productivity altered the soil structure to increase carbon storage, compensating for the greater microbial activity. A similar effect has been found in previous studies of Finnish peatland.

The researchers did note, however, that tree ring data collected from trees on the experimental plots showthat tree productivity did start falling towards the end of the study period, possibly as the trees exhausted soil nutrients or as the water table crept upwards as drainage ditches filled in naturally.

Despite the higher carbon accumulation rates, the drained peat soil would still be expected to lose large amounts of carbon due to wildfires. As wildfires tend to affect the same area of peatland once every 120 years in this region of Canada, the drained peat would not accumulate carbon fast enough to replenish the carbon content of the soil before the next wildfire struck. As a result, the effects of climate change are likely to turn many areas of boreal peat into carbon sources in future.

Source: Turetsky, M.R., Donahue, W.F., & Benscoter, B.W. (2011). Experimental drying intensifies burning and carbon losses in a northern peatland. *Nature Communications* 2:514.

Contact: mrt@uoguelph.ca **Theme(s):** Climate change and energy, Natural hazards, Soil